

DSAI-DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

DSAI 1421 Introduction to Artificial Intelligence Engineering 1 Credit Hour

Prerequisite: ENGL 1113. This 1-hour course provides an introduction to the transformative role that Artificial Intelligence (AI) plays in modern engineering practice. Students will explore how AI techniques are applied across multiple engineering disciplines, including civil, industrial and systems, chemical, biomedical, aerospace, and mechanical engineering. Emphasis is placed on real-world examples, ethical considerations, and future career opportunities in AI-enabled engineering. (Sp)

DSAI 2823 Discrete Mathematics for AI 3 Credit Hours

Prerequisite: MATH 2423. This course covers key concepts of discrete mathematics essential to computing, data science, and engineering. Emphasizing logic, set theory, combinatorics, recursion, and graph theory, it builds mathematical reasoning and algorithmic thinking. Students learn to model and analyze discrete systems, construct proofs, and apply graph-theoretic methods to solve computational and network-based problems. (F)

DSAI 3013 Machine Learning for Data Science 3 Credit Hours

Prerequisite: CS 1213 or CS 1313 or CS 1321 or CS 1323 or CS 1324, and departmental permission. Machine Learning for Data Science provides a broad overview of widely accepted and state-of-the-art machine learning approaches to automatically extract information from a variety of data types. This course will include conceptual background on data, methods, and application approaches; coverage of issues of data security, privacy, and ethics related to machine learning; and practical, hands-on exercises. (Irreg.)

DSAI 3023 Big Data Engineering 3 Credit Hours

Prerequisite: DSAI 3013, and CS 1213 or CS 1313 or CS 1321 or CS 1323 or CS 1324, and departmental permission. Students in this course will develop basic ability to design, build, and implement data pipeline systems to allow efficient access to data and databases. Several topics will be covered including data wrangling, data ingestion, and storage engines. Cloud based systems for data processing and distributed computing will also be discussed. (Irreg.)

DSAI 3123 Machine Learning Operations and Model Management 3 Credit Hours

Prerequisite: DSAI 3023. This course introduces the principles and practices for deploying, monitoring, and maintaining machine learning systems in production. Students learn model lifecycle management, CI/CD for ML, data pipelines, containerization, and cloud-based deployment. Emphasis is placed on scalability, monitoring, governance, and ethical considerations through hands-on implementation of full ML systems. (F)

DSAI 3203 Scientific Machine Learning 3 Credit Hours

Prerequisite: MATH 2443, MATH 3333, DSAI 3013. This course explores how scientific computing and machine learning combine to model complex physical systems. Students learn to integrate physical laws and constraints into ML models using methods like Physics-Informed Neural Networks, Neural ODEs, and operator learning. Applications include fluid dynamics, materials science, and geoscience, culminating in a SciML project. (Sp)

DSAI 3333 Data Visualization 3 Credit Hours

Prerequisite: CS 1323 and ISE 3293. The objective of this course is to introduce students to the principles and practice of data visualization. The course will also provide an introductory level of competency on the use of software tools (Tableau) that can be used for data visualization. We will also have hands-on exercise sessions in which students will have the opportunity to put material into practice. (Sp)

DSAI 4003 Applied Data Science 3 Credit Hours

Prerequisite: DSAI 3013 and DSAI 3023, and CS 1213 or CS 1313 or CS 1321 or CS 1323 or CS 1324; and departmental permission. In this course you will complete multiple larger-scale team projects on real-world complex data sets. The projects will allow you to develop and continue to refine your skills in problem identification, data visualization, data wrangling, data organization, machine learning, communication, and presentation. (Irreg.)

DSAI 4014 AI Capstone Project 4 Credit Hours

Prerequisite: DSAI 4323. This course focuses on real-world application of the skills taught in DSAI courses. The student will complete a project that leverages AI/ML applications to a problem in their area of first principles engineering concentration. (Sp)

DSAI 4323 Ethics and Compliance of AI 3 Credit Hours

(Slashlisted with DSAI 5323) Prerequisite: Junior standing; MATH 2423 and DSAI 4003 (may be waived with instructor approval). This course provides a survey of legal and ethical topics associated with artificial intelligence (AI). During the first half of the course, global laws and regulations associated with AI and ML will be reviewed. In the second half of the course, the algorithmic causes of bias will be reviewed, and methods to alleviate those will be discussed. No student may earn credit for both 4323 and 5323. (F, Sp)

DSAI G4413 Algorithm Analysis 3 Credit Hours

(Crosslisted with C S 4413) Prerequisite: (CS 2413 or CS 2414 and CS 2813 or MATH 2513) or CS 5005 or DSAI 5005. Design and analysis of algorithms and measurement of their complexity. This course introduces various algorithm design strategies—divide and conquer, greedy principle and dynamic programming—to solve a variety of problems using algorithms of various types: deterministic and randomized, serial and parallel, centralized and decentralized, and program based and circuit based. (F)

DSAI G4513 Database Management Systems 3 Credit Hours

(Crosslisted with C S 4513) Prerequisite: (C S 2413 or CS 2414, and (C S 2813 or MATH 2513) or C S 5005 or DSAI 5005. The design and implementation of a DBMS including data models, query languages, entity-relationship diagrams, functional dependencies, normalization, storage structures, access methods, query processing, security and transaction management, and applications. The impact of databases on individuals, organizations, and society, and legal and professional responsibilities including security and privacy will be discussed. A commercial DBMS is used. Students practice written communication skills. (F)

DSAI 4523 Reinforcement Learning 3 Credit Hours

Prerequisite: DSAI 3023 and DSAI 4603. This course will introduce reinforcement learning (RL), a machine learning method that solves problems through the use of agents. Agents explore a state/action/reward space through trials to determine strategies for problem solving. The course begins introduces RL with a discussion of multi-armed bandits and progresses to Markov decision processes, Deep Q Learning, on-policy and off-policy learning. (Sp)

- DSAI 4603 Deep Learning 3 Credit Hours**
Prerequisite: MATH 2443, MATH 3333, DSAI 3013, and DSAI 2823. This course provides an in-depth exploration of deep neural networks from both a theoretical and engineering implementation perspective. Topics include forward and backward propagation, gradient-based optimization, convolutional and recurrent architectures, transformer-based networks, normalization and regularization methods, and deployment strategies. Students will gain hands-on experience implementing deep-learning models in PyTorch, analyzing convergence behavior, and optimizing performance across different hardware environments. (F)
- DSAI 4613 Generative AI 3 Credit Hours**
Prerequisite: DSAI 4603. This course examines the theory and practice of generative models for creating text, images, audio, and code. Students explore probabilistic foundations, diffusion and energy-based models, adversarial and autoregressive methods, and large language models. Hands-on projects include building and fine-tuning GANs, VAEs, diffusion models, and LLMs, plus prompt engineering and output evaluation. (Sp)
- DSAI 4970 Special Topics/Seminar 1-3 Credit Hours**
1 to 3 hours. Prerequisite: Senior standing or permission of instructor. May be repeated; maximum credit nine hours. Special topics or seminar course for content not currently offered in regularly scheduled courses. May include library and/or laboratory research and field projects. (Irreg.)
- DSAI 5001 Data Analytics and Media 1 Credit Hour**
Prerequisites: Departmental permission; graduate standing. This course covers the application of data analytics to the media environment. Students will learn the application and usage of data analytics in media and its effectiveness; and how data analytics provides research tools to collect audiences' opinion on political, social, public issues, and consumers' responses to the brand. (Irreg.)
- DSAI 5005 Computing Structures 5 Credit Hours**
(Crosslisted with C S 5005) Prerequisite: CS 2334, MATH 1914 or MATH 1823 or with permission of graduate liaison. This course covers discrete mathematics, object oriented programming in C++, and C++ data structures. Students study combinatorics, logic, relations, functions, computational complexity, automata, and graph theory, and learn core OOP principles for designing and analyzing data structures. Credits earned in this course do not count toward degree requirements for the B.S., M.S., or Ph.D. programs in computer science. (Irreg.)
- DSAI 5011 Introduction to R 1 Credit Hour**
Prerequisites: departmental permission; graduate standing. R is a free open source statistical programming language used by professionals in every field and industry. This introductory course aims to provide students with the fundamentals of R and R Studio. Instead of passively watching videos, students will apply R to solve real data problems while receiving instant and personalized feedback that guides them to the correct solution. (Irreg.)
- DSAI 5013 Fundamentals of Engineering Statistical Analysis 3 Credit Hours**
(Crosslisted with ISE 5013) Prerequisite: graduate standing. Introduction to probability, expectation, discrete and continuous distributions, sampling and descriptive statistics, parameter estimation, and statistical tests to aid decision making. The student will learn analysis techniques for verification of systems parameters. (F, Sp)
- DSAI 5021 Data Analytics Applied to Meteorology Data 1 Credit Hour**
Prerequisites: departmental permission; graduate standing. This course focuses on meteorology data that is stored regularly in space and time, so-called gridded data. For example, satellite or forecast data that is stored in a specific latitude-longitude grid, and available at uniform increments in time. Analysis of gridded data is abetted by programming in Python, offering an array syntax that exploits the uniformity of data. (Irreg.)
- DSAI 5031 Econometrics for DSA 1 Credit Hour**
Prerequisite: Graduate standing and departmental permission. The main goal of this course is to learn a set of econometrics tools that can be applied in empirical research related to economic issues. The course will emphasize applying different estimation techniques, or quasi-experimental methods, to establish causal relationships in observational data. (Irreg.)
- DSAI 5041 Advanced R 1 Credit Hour**
Prerequisite: Graduate standing in DSAI/C S/ISE and DSAI 5011, or departmental permission. R is a free open source statistical programming language used by professionals in every field and industry. This course will provide students with detailed knowledge of R and R Studio. Instead of passively watching videos, students will apply R to solve real data problems while receiving instant and personalized feedback that guides them. (Irreg.)
- DSAI 5051 Data Visualization 1 Credit Hour**
Prerequisite: Graduate standing in DSAI/C S/ISE and departmental permission; DSAI 5103 and DSAI 4513 recommended. Aspiring data scientists need to be able to communicate the stories of data to communities of interest. This usually requires the depiction of data in visualizations. The course combines an overview of best practices for visualizations with practical knowledge, including the use of Tableau and how to gather user requirements. (Irreg.)
- DSAI 5061 Python for Data Science and Analytics 1 Credit Hour**
Prerequisite: Graduate standing, C S 1313 or C S 1323, and departmental permission. This course introduces core programming basics, including data types, control structures, and algorithm development with functions via the Python programming language for students without prior programming experience. The course discusses the fundamental principles of Object-Oriented Programming and their application in data science and analytics. (Irreg.)
- DSAI 5103 Intelligent Data Analytics 3 Credit Hours**
(Crosslisted with ISE 5103) Prerequisite: graduate standing or permission of instructor; ISE 3293 or ISE 5013; CS 1313 or CS 1323. This course explores intelligent data analysis as a holistic approach to extracting insight from complex, rapidly growing data. Students learn to define problems, work with diverse data, apply analytical tools, and communicate findings. Topics include cleansing, visualization, dimension reduction, regression, decision trees, and clustering. The course uses R and emphasizes hands on analysis and team projects. (F)
- DSAI 5113 Advanced Analytics and Metaheuristics 3 Credit Hours**
(Crosslisted with ISE 5113) Prerequisite: ISE 5013, graduate standing or permission of Instructor. Explores advanced techniques for addressing complex optimization problems. Focus is on formulating mathematical models and developing problem solving strategies using methods in the context of Data Science and Analytics. Topics include continuous and combinatorial optimization with an emphasis on both traditional and modern heuristic techniques. (Sp)

- DSAI 5133 Energy Analytics** **3 Credit Hours**
 (Crosslisted with ISE 5133) Prerequisite: Graduate standing or permission of instructor. In today's data-driven world, the ability to extract knowledge and create successful future energy projections is critical for the energy sectors. In this regard, data science body of knowledge promises a strong set of analytical tools that can be used for demand/supply forecasting and price prediction. This course aims at teaching the students the fundamentals of data analysis and interpretation. (F)
- DSAI 5203 Time Series Analysis** **3 Credit Hours**
 Prerequisite: DSAI/ISE/C S graduate standing or Departmental permission. This course will cover data mining and time series analysis. Modules include: statistical estimation, transformations and decomposition of time series, quantifying correlation structure in standard models, forecasting methods, linear least squares method, and volatility models. Students will utilize MATLAB Time Series Tool Box and open source programs in R. (Irreg.)
- DSAI 5303 Financial Engineering Analytics** **3 Credit Hours**
 Prerequisite: departmental permission or DSAI/ISE/C S graduate standing. Course focuses on use of optimization and stochastic models to solve portfolio optimization problems; price derivative securities including energy and weather derivatives; and applications of financial engineering, including algorithmic trading, financial networks, pricing of real options, and the use of machine learning in pricing. Data driven models and big data mining in financial engineering will be also discussed. (Irreg.)
- DSAI 5323 Ethics and Compliance of AI** **3 Credit Hours**
 (Slashlisted with DSAI 4323) Prerequisite: Graduate standing; MATH 2423 and DSA 4003 (may be waived with instructor approval). This course provides a survey of legal and ethical topics associated with artificial intelligence (AI). During the first half of the course, global laws and regulations associated with AI and ML will be reviewed. In the second half of the course, the algorithmic causes of bias will be reviewed, and methods to alleviate those will be discussed. No student may earn credit for both 4323 and 5323. (F, Sp)
- DSAI 5403 Bayesian Statistics** **3 Credit Hours**
 Prerequisite: Departmental permission or DSAI graduate standing. Course topics are models, probability, Bayes' Rule and R; inference to a binomial probability; and the generalized linear model. (Irreg.)
- DSAI 5503 Healthcare Analytics** **3 Credit Hours**
 (Crosslisted with ISE 5503) Prerequisite: Graduate standing and ISE 3293 or ISE/DSAI 5013. This course gives an overview of the primary concepts and methods towards developing artificial intelligence (AI)-enabled healthcare systems. We will focus on foundational methods in machine learning and data analytics for prediction and pattern recognition, and apply them to specific areas in medicine and healthcare including, but not limited to, disease diagnosis, patient treatments and their outcomes prediction. (Sp)
- DSAI 5703 Machine Learning Practice** **3 Credit Hours**
 (Crosslisted with C S 5703) Prerequisite: Graduate standing; C S 4013/5013, C S 5593, or ISE/DSAI 5103; or permission of instructor. Machine learning is the data-driven process of constructing mathematical models that can be predictive of data observed in the future. In this course, we will study the use of a range of supervised, semi-supervised and unsupervised methods to solve both classification and regression problems. (F)
- DSAI 5900 Professional Practice** **1-4 Credit Hours**
 1 to 4 hours. Prerequisite: Completed or concurrent enrollment in DSAI 5103, DSAI 5113, DSAI 4413, and DSAI 4513. Graduate standing and departmental permission. May be repeated; maximum credit four hours. Participation in a professional experience with an approved project sponsor and topic. A written report detailing the responsibilities and results of the experience is required upon completion along with an oral presentation. (F, Sp, Su)
- DSAI 5970 Special Topics/Seminar** **1-3 Credit Hours**
 1 to 3 hours. Prerequisite: permission of instructor. May be repeated with a change of subject matter; maximum credit 12 hours. Selected topics of current research interest not covered by regularly scheduled coursework. (F, Sp, Su) (Irreg.)
- DSAI 5980 Research for Master's Thesis** **2-9 Credit Hours**
 2 to 9 hours. Prerequisite: Graduate standing and departmental permission. Variable enrollment, two to nine hours; maximum credit applicable toward degree, six hours. (F, Sp, Su)
- DSAI 5990 Independent Study** **1-3 Credit Hours**
 1 to 3 hours. Prerequisite: Graduate standing and permission of instructor. May be repeated; maximum credit nine hours. Contracted independent study for a topic not currently offered in regularly scheduled courses. Independent study may include library and/or laboratory research and field projects. (Irreg.)
- DSAI 6980 Research for Doctoral Dissertation** **2-16 Credit Hours**
 2 to 16 hours. Prerequisite: Graduate standing and permission of instructor; may be repeated. Directed research culminating in the completion of the doctoral dissertation. (F, Sp, Su)